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ABSTRACT

Safety information is discussed and outlined in this guide. Areas include: (1) general laboratory safety rules; (2) general rules and guidelines for animals in the elementary classroom; (3) general guidelines for the physical sciences; (4) general rules for using animals in investigations, with specifics on the care and handling of mammals, reptiles, insects/spiders, protozoans, and preserved specimens; (5) precautions when using plants; (6) earth science guidelines; (7) field trip guidelines; (8) alphabetical list of hazardous or incompatible chemicals likely to be encountered by students; (9) special instructions relating to glass, x-ray equipment, model rockets, radioisotopes, non-ionizing radiation, lasers, and electricity and electronic equipment; (10) storage, labeling, and disposal of chemicals; (11) list of basic first aid supplies; (12) first aid procedures; and (13) laboratory safety checklist. (SK)

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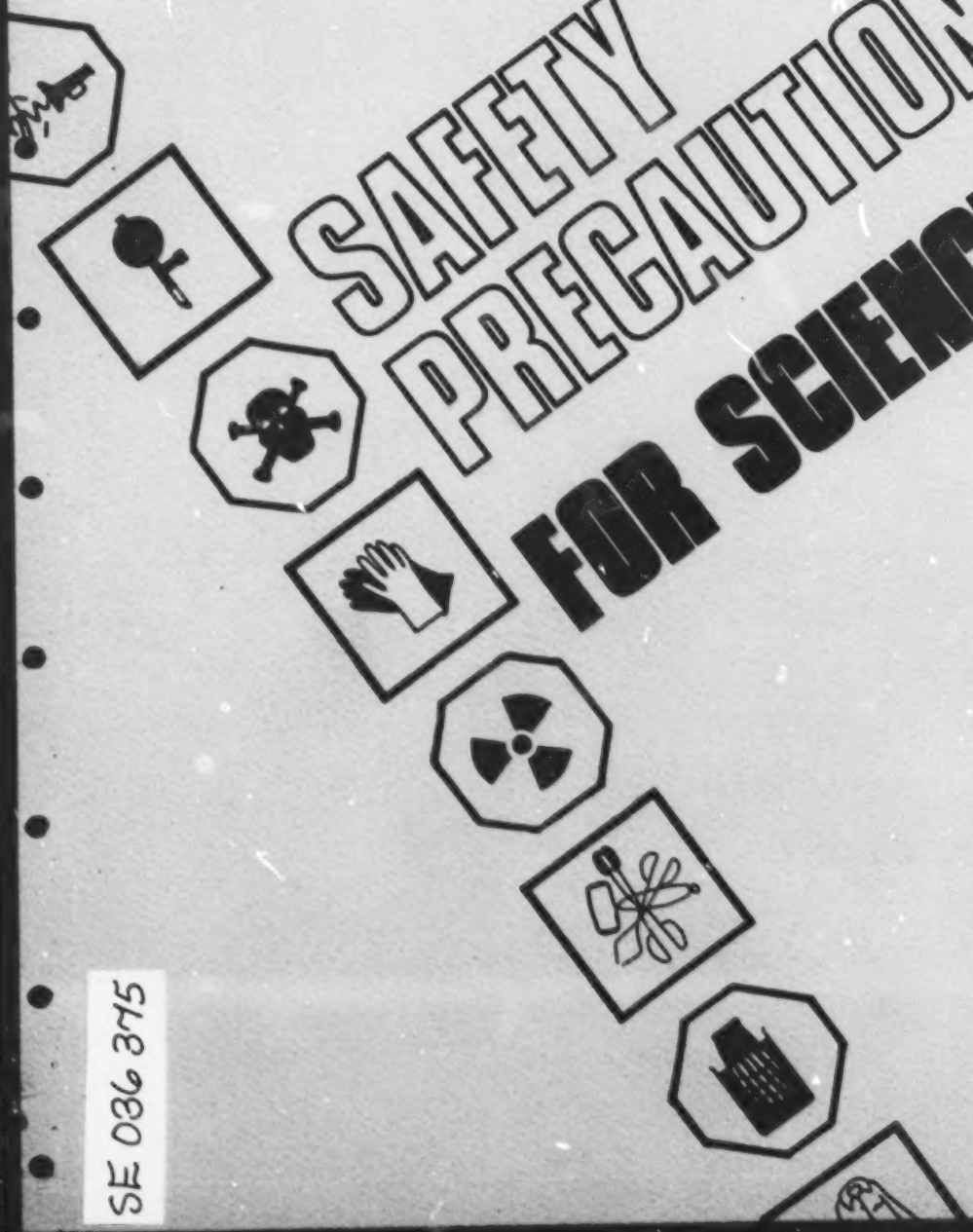
SAFETY PRECAUTIONS FOR SCIENCE



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SAFETY PRECAUTIONS FOR SCIENCE

Oklahoma
State Department of Education

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FOREWORD

The responsibilities of a science teacher are many and varied. Not only must you teach subject content, but you must also be constantly aware of the risk factor involved in the many laboratory experiments, field trips, and group projects of your students. Exposure to an increasing variety of activities has broadened the need for additional information to ensure safety at all times in both the indoor and outdoor science laboratories.

A teacher must rely to some extent on the responsibility and maturity of students to conduct themselves in a safe and proper manner. Distribution of written procedures does not in itself relieve teachers of their professional liability.

To avoid becoming involved in litigation as the result of a student injury, you should:

- Take nothing for granted.
- Make safety a part of the everyday science activities.
- Give safety instructions prior to any experiment or field trip.
- Establish and adhere to safety rules.
- Review and use this and other appropriate safety literature.

This booklet is designed to remind teachers of possible dangers involved in science instruction and to suggest ways of avoiding them.

Safety and safety related activities in the public schools are matters of concern for administrators, teachers, parents, and students. When all of these persons work together, the frequency of incidents can be reduced and the severity of accidents can be minimized.

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RECOMMENDED SAFETY PROCEDURES

The following recommendations for providing for the safety of students performing laboratory investigations are grouped under the headings: General Laboratory Safety, Safety in the Elementary Science Classroom, Physical Science, Life Sciences, and Earth Science.

GENERAL LABORATORY SAFETY

Most accidents can be avoided by replacing unsafe habits with safe practices. The main causes of accidents are: (1) carelessness, (2) insufficient knowledge, (3) taking unnecessary risks, or (4) being in too great a hurry.

It is your responsibility to:

- Review each experiment or demonstration prior to allowing students to replicate the activity. Look for possible hazards and alert students to potential dangers. Safety instructions unique to a laboratory activity are to be given each time an experiment is begun.
- Never to assume an experiment is free of safety hazards just because it is found in a commercial publication.
- Promote positive student attitudes toward safety. Students should not fear doing experiments, using reagents or equipment, but should respect them for potential hazards.
- Maintain constant surveillance and supervision of student activities. A partial glass partition between lecture area and laboratory is a convenient way to provide visual monitoring.
- Set good safety examples when conducting demonstrations and experiments.
- Observe good housekeeping in maintaining safe laboratory conditions.

In addition, you should see that the following rules and suggestions are adhered to when laboratory investigations are being performed:

- Contact lenses should not be worn in the laboratory.
- Long hair is to be confined and no loose clothing worn. Laboratory aprons should be worn.

- Proper eye protection devices are to be worn when engaged in, supervising, or observing science activities involving potential hazards to the eye.
- All hot plates and gas burners are to be turned off when not in use.
- Frequent safety inspections of the laboratory are to be conducted. Any hazards are to be reported in writing to the building principal.
- Fire blanket(s) and fully-charged fire extinguisher(s) shall be located in each laboratory.
- Chemistry laboratories should contain an emergency shower, eye-wash fountain, separate room exhaust system, and approved safety goggles for all students, teacher(s), and visitors.
- Each laboratory should have two unobstructed exits.
- For safety reasons, one teacher should not supervise more than 24 students engaged in laboratory activities at any one time.
- After each use, all work surfaces in the chemical and biological laboratory are to be thoroughly cleaned.
- Ventilation systems in chemistry laboratories should be functional. Fume hoods should be used in any activity involving flammable or toxic substances.
- Food and beverages are not to be allowed in the laboratory, and laboratory equipment should not be used to drink from.
- Care is to taken in noting odors or fumes from a bottle. A waffing motion of the hand is to be used to bring a sample of the vapor to the nose.
- A suction bulb, not mouth suction, is to be used in filling pipettes with chemical reagents.
- Safety items such as safety tongs, heat insulated mittens, aprons, and rubber gloves are to be used.
- Master controls for all utilities should be conveniently located and available to the laboratories served.
- All master cutoff valves and switches for rooms under the science teacher's supervision should be located before laboratory work is begun.

Proper storage practices are essential to the safe operation of a laboratory. The following precautions should be taken into consideration:

- Laboratory chemicals and equipment should not be stored in the same room.
- Storage rooms containing flammable, toxic, or combustible substances should be properly ventilated.
- The chemical storage area should be secured at all times when not in use, with access only to authorized personnel.
- Combustible chemicals are to be locked in a fire-resistant cabinet.
- Flammable or toxic gases are to be stored at or above ground level.
- Gas cylinders should be secured against falling over and should be stored away from heat sources.
- All chemicals are to be labeled and separated according to class. (Reducing agents are not to be stored with oxidizing agents.)
- A fire extinguisher must be immediately accessible. (The multi-purpose type is safe to use on Class A, B, and C fires.)
- Chemicals are to be mixed and transferred only in well-ventilated and properly equipped areas.
- Storage areas should have unobstructed access aisles.
- Open flames, smoking, or any other type of heat is not to be permitted in the chemical storage area(s).
- Cleanliness and order in the storage area is to be maintained at all times.
- Chemical storage areas should be well ventilated and lighted.
- Acids and other solvents are to be stored on or near the floor level.

Electrical equipment is frequently used in laboratory investigations, including physical, biological, and earth science courses and in activities with elementary students. The following are general guidelines that are to be followed whenever electrical equipment is used.

- Students should be taught safety precautions regarding the use of electricity in everyday situations.
- Students should be cautioned to exercise care when using electrical current.
- Batteries or cells of 1.5 volts or less are safe for classroom use. However, the battery may explode if heated or thrown into an open fire. The chemicals inside the battery can be dangerous if taken internally.
- The use of a 110-volt (or greater) line should be approached with caution.
- Electrical equipment should be properly grounded.
- A portable ground-fault circuit breaker should be used for all laboratory AC circuits during laboratory investigations.
- A master switch to cut off electricity to all stations should be available for all laboratory AC circuits.
- Properly-grounded service outlets and only three-wire extension cords are to be used.
- Electrical wires with worn or frayed insulation are not to be used.
- Metal water and gas pipes are grounded. A ground and an electrical circuit are never to be touched simultaneously.
- Work areas, including floors and counters, should be dry.
- Electrical equipment is never to be handled with wet hands or while standing in a damp area.

SAFETY IN THE ELEMENTARY SCIENCE CLASSROOM

A safe environment for the student to make science discoveries can be provided by the use of common sense along with a few appropriate rules. Most of the following rules and safety practices apply to the elementary classroom as well as to the secondary science classroom, however, some special precautions must be taken into consideration when working with elementary students. Elementary students are very curious, however, they are not yet wise in the ways of avoiding personal injury. The attitudes of students about their world may become quite positive as a result of safe learning experiences in science.

Instruct students to report any accident to you immediately. For minor injuries, immediately notify the principal and/or school nurse and see to it that first aid is administered by a trained person. For more serious injuries, notify the parent or guardian as soon as possible. Keep an emergency number on file for an alternate or family doctor. Call emergency help if necessary.

General rules to remember are:

- Be knowledgeable of your school's policy and procedures concerning injuries.
- Be knowledgeable of your school's policy and procedures about classroom management.
- Be knowledgeable of your school's fire regulations.
- Perform regularly a safety check of your classroom.
- Never allow students to touch, taste, or smell any substance without first obtaining specific instructions from you, the teacher.
- Instruct students that it is unsafe to touch their face, mouth, or eyes while they are working with plants.
- Do not allow students to mix any chemicals without proper instructions.
- Instruct students in the proper handling of glassware. Substitute plastic containers when possible to minimize hazards.
- Do not allow students to perform any electrical experiment without proper instructions and supervision.

Guidelines for having animals in the classroom are:

- Discourage students from bringing personal pets into the classroom. Personal pets should be handled only by their owners.
- Do not allow students to tease an animal or thrust their fingers into its cage.
- Instruct the students to handle the animals with care and use gloves where possible.
- Be sure that no diseased animals are brought into the classroom.
- Check with the school and local authorities concerning regulations on handling small animals.

Guidelines for having plants in the classroom are:

- Do not allow students to handle any unidentified or unfamiliar plant.
- Be sure students wash their hands immediately after handling plants before they touch their eyes, mouth, or face.
- Be familiar with poisonous plants found in your area.
- Do not place any plant or part of a plant in the mouth.

PHYSICAL SCIENCE

The following are guidelines you must insist students follow when performing physical science (physics, chemistry, or physical science) laboratory investigations:

- Use proper protective devices (goggles, aprons) when hammering, chipping, or grinding rocks, minerals, or metals.
- Never view the sun directly.
- Never look directly into ultraviolet light sources without proper eye protection.
- Never point the open end of a heated test tube toward anyone. Rapid heating of substances may cause contents to be violently ejected.

- Use volatile liquids such as ether, gasoline, alcohol, carbon disulfide, and benzene in very small quantities in a well-ventilated room. Heat such substances electrically or in water baths; never bring them near a flame.

- Use glassware that is neither cracked nor chipped.

- Never directly breathe any prepared gases; all are dangerous in high concentrations. Breathing only carbon dioxide will result in unconsciousness within a matter of seconds.

- Never taste any laboratory chemical. Eating and drinking in the laboratory should be prohibited.

- When heating materials in glassware by means of a gas flame, place the glassware on a wire gauze.

- Pour acid into water while stirring, never water into acid.

- Promptly remove broken glass from sinks.

- Operate the fume hood and/or room exhaust fan when dealing with highly volatile, toxic fumes.

- When working with flammable liquids, remember:

  Have a CO_2 or multipurpose fire extinguisher available.

  Work in a well-ventilated area.

  Keep the liquid over a pan or sink.

  Use no flames or high-temperature heating devices.

  Do not store flammables in a home-type refrigerator. Fumes may be ignited by sparks produced in the electrical switching system. (Explosion-proof refrigerators are available from science supply houses or appliance stores.)

- Never heat a battery or throw one into an open fire.

- Use high voltage AC (such as 110-volt wall socket) only under proper supervision. Be sure the circuit is properly grounded.

- Never direct a student to conduct unsupervised experiments with household current.

- Be sure all work areas are dry before beginning an experiment in which electrical equipment is used. Never handle electrical equipment with wet hands.
- Avoid using multipurpose plugs in electrical outlets; circuits can quickly become overloaded.
- Do not use electrical wires with worn insulation.
- Use properly-grounded service outlets.
- Locate the master switch for cutting off electricity to all stations before beginning electrical experiments.
- Never permit students to apply a voltage to a device which uses an electron beam except under supervision, as all are capable of producing X rays.
- Become thoroughly familiar with the potential hazards of and proper safety precautions for using X-ray equipment or devices capable of producing X rays before using them.
- Never operate a laser without becoming familiar with laser safety. Even low power helium-neon lasers are potentially hazardous, producing effects that may not be immediately evident.
- Handle mercury with care. It is poisonous and the effects are cumulative.
- Collect spilled mercury by pushing the pools (droplets) together using index cards. Next use an aspirator to gather up the mercury. An aspirator is made by attaching a suction bulb to the blowing tube of a wash bottle, a fine pipette, or capillary tube to the spout tube. Then sprinkle the area with sulphur, leave for a short period of time, then sweep up.
- Never decompose mercuric oxide, either as an experiment or as a teacher demonstration.
- Never permit students to operate model rockets without first providing safety instructions. Carefully supervise all activities involving the use of model rockets.
- Exercise caution when using alcohol lamps. An alcohol flame is hard to see and can easily ignite hair or loose-fitting clothes.
- Never permit students to move a lighted alcohol lamp across the room. Should it be dropped; the flame can cover a large area instantaneously.

LIFE SCIENCES

Live animals and plants are essential to the study of the life sciences. Their indiscriminate care and use in the classroom, however, may introduce students to unnecessary safety risks. Additional risks are present, outside the classroom, that must be taken into consideration prior to conducting outdoor investigations and field trips.

Animals In The Classroom

The use of live animals in the classroom is essential if students are to fully understand and appreciate life processes. Students, regardless of age, need ample opportunities to observe and experiment with living organisms. Be sure to establish and review with students safety guidelines prior to handling living organisms. This protects students and helps ensure the humane treatment of animals.

The following guidelines should be followed in laboratory investigations:

- When living organisms are needed, use species such as plants, bacteria, fungi, protozoa, worms, snails, or insects. They are readily available, simple to maintain, and easy to dispose of, making them especially suitable for student work.
- Never use a procedure on a warm-blooded animal that might cause it pain or any type of discomfort.
- Never perform surgery on a living vertebrate animal.
- Do not perform experiments with vertebrates that inflict harm, disease, or discomfort.
- Student experiments involving the observation of animals must be closely supervised by the teacher.
- Animals used for study must be properly fed, given sufficient water to drink, provided with ample living space, and handled humanely at all times.
- Embryos used for investigation must be killed no later than the 19th day of incubation. If embryos are to be hatched, proper arrangements must be made for the care or humane disposal of the younglings (such as chicks).
- All mammals used in the classroom must have been inoculated for rabies.

Observe the following general safety recommendations regarding the use of animals in the classroom:

- Do not permit students to bring pets to the classroom unless the activity has been carefully planned.
- Have students wash their hands after handling animals.
- Caution students never to tease animals.
- Return native animals to their environment after the observation period.

The following recommendations apply to specific types of animals normally maintained in the classroom.

MAMMALS

Care:

- Cages shall be cleaned and disinfected a minimum of once per week.
- Cages shall be draft-free with secure lids and/or doors to prevent escape or unauthorized handling.

Handling:

- Remove a mouse or a gerbil from the cage by grasping the base of the tail; support the body with the other hand.
- Remove a guinea pig by grasping the forequarters with one hand and placing the other hand underneath the hind-quarters.
- A hamster should be removed by grasping the nape of the neck (scruff of the neck) between the thumb and forefinger.
- Do not grab a small mammal around the major portion of the body as this usually results in a bite.
- Do not free small mammals to explore table tops or other areas where falls or injury may occur.
- Handle all small mammals gently and quietly and never squeeze them.

REPTILES

Care:

- Keep native reptiles in cages with secure tops and/or doors to prevent their escape. Be sure there are no openings or loose fitting tops through which reptiles could escape.
- Make cages of solid wall construction with one side modified for ventilation.
- Maintain a temperature in a 78-85°F. range.
- Construct cages of appropriate size to allow exercise.
- Be sure that the wire mesh used for ventilation is of sufficient size to prevent escape.
- Clean and disinfect cages once each week.
- Provide a water bath.
- Know the nutritional requirements of each reptile and provide the appropriate amounts of food at weekly intervals.
- Some reptiles require small mammals for feeding. Be sure to remove uneaten ones after it is determined that the reptile is not going to feed.
- Never disturb a feeding reptile, especially a snake. When disturbed, the reptile may regurgitate the food and possibly strangle.
- Never allow fecal material from reptiles to be placed in sinks, drinking vessels, or any lab equipment used by humans. Infection may result.

Handling:

- When tame snakes are handled, take care not to squeeze them.
- To remove a snake from its cage, place one hand under the first third of the body, the other hand slightly past the animal's center, and remove it gently.
- Never allow untrained persons to handle snakes known to bite.

- Move with caution in the presence of a snake. Rapid, sudden movements may induce a strike from even a tame snake.

- A snake is about to shed when its eyes are cloudy. To avoid a possible bite, never handle a shedding snake until the process is complete.

- Unless immediate supervision is present, never keep poisonous reptiles in the classroom.

- Never examine freshly-killed, poisonous reptiles without immediate supervision. A reflex bite may be sustained.

- Handle lizards by grasping the full body in one hand, firmly, but gently. Never attempt to pick up a lizard by the tail.

- Most tortoises may be held by placing both hands on the edge of the top shell and curling the fingers around the edges to the lower shell. CAUTION: Loggerheads and softshell turtles can inflict serious injury and should be handled only by persons knowledgeable in such procedures. Wash thoroughly after handling turtles; they are carriers of salmonella.

- Return native reptiles to their natural environment after observing them.

A state permit, available from the Permit Division, Oklahoma Wildlife Department, is required to have a protected animal in your possession. A permit is also required if unusual trapping techniques are to be employed in the capture of native wildlife.

INSECTS AND SPIDERS

Care:

- Keep spiders and insects in a clear glass or plastic container with a secure screen-wire lid.

- Duplicate the animals' natural environment as closely as possible.

- Provide adequate amounts of the proper food.

- Most spiders and insects have a short life span, making a three- to four-day observation period adequate. Release them in the same general area as captured.

- Never keep poisonous insects or spiders in the classroom without the immediate supervision of a trained person.

Handling:

- Many of these organisms are fragile and should not be handled when alive. Large specimens may be handled with care.
- Kill insects and spiders in jars with alcohol vapor or carbon dioxide. Cyanide compounds are quite dangerous and should be avoided.

PROTOZOANS

Bacteria:

- Even though bacteria normally used in public schools are non-pathogenic, handle all cultures as if they are.
- Tape shut all culture plates following inoculation.
- Destroy cultures either chemically or with heat following a laboratory exercise.
- Instruct all students in bacteriological techniques and insist they be followed while conducting experiments.

Fungi:

- Use the same procedure with fungi as with bacteria.
- Never allow persons to taste or ingest any of the fungi such as locally-collected mushrooms, penicillium, or rhizopus.

Liquid Cultures:

- Never taste or ingest a liquid protozoan culture.

NOTE: E. coli can irritate the mucous membranes of the eyes, nose, and ears.

PRESERVED SPECIMENS

- When dissecting specimens preserved in formalin, the vapor may cause eye or epidermal irritation. To avoid this, bathe the specimens in fresh water for 24 hours prior to their use.
- Use scissors for dissecting specimens, not razors or double-edged scalpels.

PLANTS IN THE CLASSROOM

The use of plant life in the classroom is both educationally sound and aesthetically pleasing. Normally, there are few precautions to be heeded in relation to plants, however, you must be mindful of their potential dangers as well as their beauty. Each locale across the state has plants that are native, cultivated, or introduced that present hazards of either a mechanical or chemical nature.

Thorns are the most obvious mechanical problem encountered in plants used in the field or classroom situation. Students in both situations should not be allowed to use such plant materials for projectiles or other types of "horseplay." Some species of grasses, such as spear grass and grass burrs, possess modified seeds which render them a nuisance and a possible cause of irritation. Most problems associated with plants are of a chemical nature encountered when parts of the plants are ingested or crushed on the skin. Students, especially the younger ones, should be instructed never to ingest any part of a plant in laboratory exercise or field studies without a thorough knowledge of the plant. Perhaps the best example of potential problems are the tomato and potato; both are edible, but the foliage of both plants if eaten may be fatal. Domesticated plants also have associated problems, and with the increased popularity of house plants, another dimension of concern has arisen.

Extra care must be taken with plants such as dracaenas, dumb cane (Diffenbachia sp.), and yews to prevent accidental poisoning. Much remains to be learned about the results of ingestion of many plant parts. With the increasing number of mutant strains appearing on the market, the rate of caution in their handling increases.

General plant use guidelines are :

- Be familiar with the dangerous plants in the area of study.
- Do not put any part of an unfamiliar or poisonous plant in the mouth.
- Do not rub unfamiliar or poisonous plant sap or juice into the skin or an open wound.
- Do not inhale or expose skin or eyes to the smoke of any burning plant.
- Do not pick unknown cultivated or wild flowers.
- Do not eat food or drink fluids after handling plants without thoroughly washing and rinsing the hands.

- Do not depend on folklore methods for distinguishing nonpoisonous from poisonous plants.
- Be aware of possible hypersensitivity of persons to handling plants.

REPRESENTATIVE LIST OF PLANTS, THEIR TOXIC PARTS, AND SYMPTOMS

NOTE: This list presents some well-known plants for the purpose of illustrating the precautions that should be exercised when working with plants in the laboratory or field. It is not inclusive of all hazardous plants found in the state.

Plant	Toxic Part(s)	Symptoms
Hyacinth, Narcissus, Daffodil	Bulbs	Causes nausea, vomiting, diarrhea. May be fatal.
Oleander	Leaves, branches	Is extremely poisonous, affects the heart, produces severe digestive upset, and has caused death.
Dieffenbachia (Dumb Cane) Elephant's Ear	All parts	Causes intense burning and irritation of the mouth and tongue. Death can occur if base of the tongue swells to block air passage of the throat.
Castor Bean	Seeds	Can be fatal. Single bean seed may kill child; two are near lethal dose for adults.
Mistletoe	Berries	Can be fatal.
Lily of the Valley	Leaves, flowers	Causes irregular pulse, is usually accompanied by digestive upset and mental confusion.
Iris	Underground stems	Causes severe, but not usually serious, digestive upset.
Rhubarb	Leaf blade	Can be fatal. Large amounts of raw or cooked leaves can cause convulsions, coma, followed rapidly by death.

Plant	Toxic Part(s)	Symptoms
Yew	Berries, foliage	Can be fatal. Foliage more toxic than berries. Death usually sudden without symptoms.
Wild and cultivated cherries	Twigs, foliage	Can be fatal. Contains a compound that releases cyanide when eaten. Gasping, excitement, and prostration are common symptoms that often appear in minutes.
Buttercup	All parts	Irritant juices may severely injure the digestive system.
Nightshade	All parts, especially the unripe berry	Can be fatal. Intense digestive disturbances and nervous symptoms.
Poison hemlock	All parts	Can be fatal. Resembles a large wild carrot. Used in ancient Greece to kill condemned prisoners.

NOTE: In the event a student displays plant-caused systematic reaction, contact the local poison control center for advice and recommended procedures to follow until parents are contacted.

EARTH SCIENCE

In addition to safety precautions listed elsewhere in this publication, the following are additional steps that you, the earth science teacher, must take to ensure the safety of students.

- To avoid ingestion or inhalation of particles thought to be toxic, wear a breathing mask or filter when grinding the following materials:

  Abalone shell (dry)

  Any minerals containing lead, mercury, cadmium, arsenic, copper, nickel

- Always grind, shape, or polish Abalone shell with a water spray on the wheel (irritating fumes are released when worked dry).

- Wear a mask when chrome oxide polish is being used.

- Never push hard when using a grinder. Excessive heat may build up in either the stone or machine, causing the stone to fracture, the machine to overheat, and the stone to grab and be torn from the grasp of the operator.

- Always keep the cutting surfaces of a rock cutting machine well lubricated, either with water or with light coolant oil. Running a machine dry may cause damage to the machine and/or rock.

- Use a sump or bucket to catch cuttings carried away by water or sediment from stream tables. Sink drains are quick to clog.

- Wear goggles whenever breaking, grinding, or crushing rock samples.

- Use appropriate safety techniques when looking through a telescope.

- Follow proper procedure when planning and conducting a field trip (see Field Trips).

FIELD TRIPS

Field trips are an essential part of the science curriculum. One of the most effective ways to study some of the natural phenomena is to observe them in their own settings. A field trip can be a valuable teaching/learning experience for both teacher and student. A poorly planned field trip can be a waste of time and worse than no trip at all. In addition to having well-stated educational objectives, pre-trip preparation, and effective follow-up activities and discussion, every precaution should be taken to assure the safety of students and teaching personnel while on a field trip. Observe the following general safety guidelines to make field trips safe and effective as teaching strategies:

- Visit the site prior to the actual field trip. As the teacher, you should have a thorough knowledge of the field trip area, including obvious dangers such as poisonous plants and snakes, possible waterfall areas, and electrical hazards.

- Establish rules for safe conduct prior to the trip, and make sure they are observed by all present.

- Inform students of the potential dangers of the area, especially when field trips are to be conducted near deep or rapidly-moving water. Never permit poor or nonswimmers in any body of water.

- Dress according to the demands of the terrain and weather.

- Have adequate supervision, teachers and parents, for the class size.
- Use the buddy system (a student shares responsibility for his or her partner).
- Take a well-stocked first-aid kit; include a snake bite kit.
- Be sure that proper consent forms are completed and signed, according to school policy, and turned in to you prior to departure.
- Avoid taking glass containers on the field trip.
- Include appropriate repellants to protect against mites, ticks, and mosquitoes.
- Weigh the economy of private cars for transportation against the educational benefit and safety of having all students on the same school or private bus.
- If the field trip is to include potentially hazardous activities, discuss and demonstrate proper safety procedures prior to the trip.
- Students will remain under adult supervision at all times.
- If private land is used for the field trip, obtain the land-owner's permission, preferably in writing with a disclaimer of responsibility, prior to work on that land.
- In case of a reptile bite:

  Determine whether or not the reptile is poisonous.

  If nonpoisonous, follow guidelines in the first-aid section dealing with treatment of bites.

  If poisonous, follow the directions in the first-aid manual and seek medical attention at once.

- In case of a poisonous insect bite:

  Determine the type of insect that inflicted the wound.

  For most bites and stings, a cold compress applied to the area will bring relief in a short period of time.

Should persons be hyper-sensitive to bites or stings, this must be known prior to the trip. They should have medication with them. If needed, the medication should be administered according to the doctor's directions. Closely observe the bitten or stung individual. Should medication not be available, get medical attention to the person as quickly as possible. Immediately notify the student's parents.

- Notify as soon as possible the administrators and parents of any student involved in an incident.

SCIENCE LABORATORY MANAGEMENT

To ensure the safe and effective operation of the science instructional program and to protect the investment represented by science laboratories and their physical contents, each district should appoint a person(s) to have the responsibility of the overall supervision of science laboratories. In a multicampus school district, the science supervisor(s) should coordinate the supervision of the laboratories on each campus through the respective science department chairperson. Each campus should have a person designated to be responsible for supervision of the science laboratories on that campus. The department chairperson will have numerous management and supervision responsibilities. Among these are to:

- Arrange and store chemicals.
- Prepare, label, and date stock solutions.
- Dispose of outdated reagents.
- Arrange items according to compatability in storage areas, keeping in mind that:

  Some chemicals should not be stored with some other chemicals.

  Some chemicals give off vapors that can explode in the presence of equipment that sparks.

  Bottom shelves should be used for storage of heavy or large items.

  Laboratories and storage areas should be well lighted and ventilated.

Chemicals should be ordered in quantities that will be used within a reasonable time to ensure a fresh supply. Some chemicals such as peroxides, perchlorates, chlorates, picrates, and nitrates may form unstable decomposition products upon extended storage and create a safety hazard.

Since equipment in the biological laboratories is commonly used with both corrosive materials and biological specimens that could carry pathogenic organisms, attention should be given to the supervision of their cleaning and sterilization. Too, dull and/or corroded equipment can present a safety hazard.

The department chairperson should assist and be responsible for planning, ordering, and maintaining stock items in keeping a current inventory of science laboratories. In addition, he or she will be responsible for keeping the lecture-laboratory storage areas clean and orderly and otherwise conducive to learning.

HAZARDOUS OR INCOMPATIBLE CHEMICALS LIKELY

TO BE ENCOUNTERED BY STUDENTS

Many chemicals, fortunately, give ample warning of their toxicities by obnoxious effects such as odor, lachrymation, coughing, or skin irritation. Others, like carbon tetrachloride or nitric acid, may produce serious or lethal results after a brief encounter or may cause permanent physiological damage, like lead or benzene, after long exposure without any disturbing effects or only mild irritation. Some chemicals may produce vigorous, violent, or explosive reactions or fire-explosion sensitive compounds when in contact with certain other chemicals at room temperature or at different temperatures and/or pressures.

Toxic, corrosive, flammable, and explosive characteristics of the more common hazardous chemicals are listed below for the guidance of the student. Where there is doubt, seek experience of your teacher, inspect the literature, advance with caution, experiment with small quantities, protect with shielding, and use safety glasses and/or a face shield:

ACETIC ACID (Glacial) - Hazardous with chromic acid and other strong oxidizers. Very corrosive to skin.

ACETONE - Hazardous with a mixture of concentrated H_2SO_4 and HNO_3.

ACETYL BROMIDE - Reacts violently with water or alcohol.

ACETYL CHLORIDE - Reacts violently with water or alcohol, acetic acid, phosphorus trichloride. Distillation should be done with water bath rather than hotplate to prevent inadvertent ignition of possible phosphine.

ACETYLENE - Hazardous with copper, silver, halogens, mercury.

ACETYL NITRATE - Will detonate spontaneously. Do not isolate as a pure product.

ACETYL PEROXIDE - An organic oxidizer. flammable, and hazardous with oxidizable substances (see oxidizers), and inorganic oxidizers. More sensitive and unpredictable than benzoyl chloride and will detonate at 78°C. To prevent explosion, dissolve in a nonvolatile solvent.

ACROLEIN - Violent action on the eyes.

ACROYLIC ESTERS - Without inhibitor, monomers may explode due to rapid

polymerization.

ACRYLONITRILE (Vinyl Cyanide) - Extremely toxic; gives no warning.

ALLYL ALCOHOL - Violent effect on eyes; rapidly absorbed through skin.

ALUMINUM POWDER - Explodes with CH_3Cl, $CHCl_3$, CCl_4, and mixtures.

ALUMINUM CHLORIDE (Anhydrous) - Reacts vigorously with water-forming HCl. Bottles may develop considerable pressure. To open, wrap in cloth and open behind a shield while wearing leather gloves.

AMINES - Extremely toxic; also skin irritants.

AMMONIA (Anhydrous) - Hazardous with halogens, mineral acids, calcium hypochlorite, and mercury.

AMMONIACAL SILVER NITRATE - Should be used soon after preparation and not allowed to stand overnight. Explosions are caused by presence of silver hydroxide and ammonia which forms fulminating silver. Silver nitrate should be dissolved in ammonium hydroxide and sodium hydroxide then added.

ANILINE - Hazardous with fuming nitric acid and hydrogen peroxide. Absorbed through skin.

BENZENE - More toxic than toluene or xylene because it may produce permanent damage to bone marrow through long-term chronic poisoning.

BENZOYL PEROXIDE - Strong organic oxidizer, flammable; explosive if subjected to heat by friction or grinding. Preferably handled and stored with 30 per cent water by weight. Hazardous with oxidizable substances (see oxidizers) and inorganic oxidizers. Recrystallization from hot chloroform has resulted in severe explosions. When used as an initiator of reactions with unsaturated hydrocarbons, great care should be taken to restrict the reaction rate and provide adequate means for dissipating the heat of reaction. Explosions have occurred while opening bottles.

BENZIDINE - Readily absorbed through skin; suspected of causing bladder cancer.

BROMINE - Hazardous with ammonia, hydrogen, petroleum gases, turpentine, benzene, and metal powders. Small quantity may be disposed of by dissolving in sodium hydroxide solution and pouring into drain with large quantity of water. Glass containers may break if not handled cautiously because of high density. Extremely corrosive.

BUTADIENE - When heated under pressure, violent decompositon may occur. In contact with air, it may detonate by mild heating or shock. Add an

inhibitor to prevent peroxide formation.

CALCIUM CARBIDE - Liberates acetylene with water.

CALCIUM HYPOCHLORITE - Evolves chlorine with acid or moisture.

CARBON DISULFIDE - Low ignition temperature (100°C); extremely toxic. Readily absorbed through skin.

CARBON TETRACHLORIDE - Hazardous with alkali metals. Much more toxic than most chlorinated hydrocarbons.

CAUSTIC SODA - Much heat is generated when preparing solution, so add the sodium hydroxide (lye) cautiously to the water in a wide-mouthed container at or near the sink area. Do not confine a heat-generating reaction in a stoppered or narrow-neck container. Use a face shield.

CHLORATES - (see oxidizers) A chlorate solution spilled on clothing will make the clothing readily ignitable.

CHLORINE - Same as bromine.

CHROMIC ACID - Hazardous with acetic anhydride, ethyl acetate, isoamyl alcohol, benzaldehyde, glacial acetic acid. Less hazardous with ethylene glycol, furfural, glycerol, methanol.

COPPER - Hazardous with acetylene, hydrogen peroxide.

CRESOLS - Since action on skin is rapid, prompt cleansing is required. After flushing splashes with water, excess may be removed with isopropyl alcohol.

CYANIDES - Most of the compounds liberate the highly toxic and flammable hydrocyanic acid vapor upon contact with acids and, to a lesser extent, with water. Besides the primary hazard of breathing the HCN, the salts can be readily absorbed through the skin, and, of course, are well known for their lethal property when ingested. A small kit containing amyl nitrite pearls for emergency first aid treatment should be displayed in a prominent location. DO NOT DISPOSE IN DRAIN - CALL SAFETY DEPARTMENT.

DESICCANTS - Drierite (anhydrous calcium sulfate) for general-purpose drying; calcium chloride for preliminary drying; concentrate sulfuric acid immobilized with Pyrex fiber for drying organic materials: phosphorus pentoxide for complete dehydration. Magnesium perchlorate should not be used except to dry gases. Do not confuse Dehydrite (magnesium perchlorate) with Drierite.

DIAZOMETHANE - Heated over 200°C, it may explode violently. Explosions also occur at low temperature due to traces of organic matter.

DICHLOROMETHANE - An explosion may result if sodium is used to purify since alkali metals react violently with chloroform (and other organic halides).

DIMETHYL SULFATE - Acute toxic hazard; powerful eye irritant; flush from skin with large quantity of water. Powerful methylating agent.

DRY ICE - Dry Ice is solid carbon dioxide. It causes "burns" or frostbite by bodily contact; it must not be stored in "walk-in" boxes because the carbon dioxide gas can cause asphyxiation; containers should not be tightly stoppered in order to prevent bursting pressure from developing; in preparing a low-temperature solution, the solvent should be added slowly to the Dry Ice rather than vice versa to prevent the combination from boiling over; adding Dry Ice to the solvent in order to "freshen" the low-temperature solution may cause lumping unless it is added slowly and in small pieces. Butyl cellosolve is a more satisfactory solvent than ether, acetone, or ethanol because it does not react violently, and it has a high flash point; ethanol is preferred to ether or acetone. Trichloroethylene is somewhat undesirable because of its toxicity and tendency to form phosgene and HCl upon heating. The potential fire hazard due to boiling over may be minimized by placing the container in a shallow metal collecting pan.

ETHYL ETHER - One of the more hazardous of the commonly used flammable solvents because it is highly volative, has a low flashpoint, a wide explosion range, a low ignition temperature (180°C), and often contains peroxide compounds that are powerful explosives, sensitive to heat or shock. It is not advisable to distill or evaporate any type of ether compound to dryness; it should be tested for peroxide formation prior to these particular operations. Small, infrequently used quantities should preferably be kept in the original can and kept closed with a vaccine stopper or kept in an amber-colored bottle containing an inhibitor. Particular care must be taken when disposing of ether which has been in storage for considerable periods due to possible formation of peroxides.

FORMIC ACID - (Concentrate) A strong reducing agent - hazardous with oxidizing agent. Irritating to skin, forming blisters which continue to spread even after acid has been removed. Major constituent of ant and bee venom.

HYDRAZINE - Caustic, especially dangerous to eyes. Unstable and highly explosive in vapor form. Reacts spontaneously and sometimes explosively with oxidizing agents. Absorbed through the skin.

HYDROFLUORIC ACID - Hazardous with ammonia. This is also a reagent to be treated with respect. It causes painful sores on the skin, usually not noticed until the next day. It is extremely irritating to the eyes.

HYDROGEN PEROXIDE - The 30 per cent hydrogen peroxide used in laboratories is quite a hazardous chemical. It causes severe burns, characterized by a whitening of the skin. In addition, allowing it to dry on organic material such as paper or cloth can lead to spontaneous combustion. It slowly decomposes with evolution of oxygen, requiring the container to be vented. Copper, chromium, iron, other metals and their salts cause rapid catalytic decomposition of hydrogen peroxide. Also hazardous with flammable liquids, aniline, nitrobenzene. Many persons, accustomed only to the 3 per cent H_2O_2 solution sold in stores, are unaware of these properties of the concentrated solution. Stored quantities should be provided with vent caps.

HYDROGEN SULFIDE - Hazardous with oxidizing gases, and fuming nitric acid - frequently used gas; odor of rotten eggs at low concentrate; mistakenly considered to be relatively harmless, but actually it is as toxic as hydrogen cyanide. High concentrations have sweet smell. Presence is deceiving because it quickly desensitizes nose. Use only with good exhaust ventilation. Forms explosive mixtures with air. Changes to sulfur dioxide when discharged, as from a Bunsen burner, and is ignited.

LITHIUM ALUMINUM HYDRIDE - Hazardous with water. Not safe for drying methyl ethers. Destroy with ethyl acetate.

MAGNESIUM - In finely divided form, it liberates hydrogen in contact with water.

MAGNESIUM PERCHLORATE - Explosive on contact with acids and reducing materials; do not use as drying agent except for gases only.

METAL HYDRIDES - Hazardous with water and chlorinated or fluorinated solvents. Equipment should be flushed with nitrogen before using. The following compounds will ignite and frequently explode with water: NaH, $LiAlH_4$, KH, $NaAlH_4$. Following will react with water but usually do not ignite: LiH, SrH_2, $NaBH_4$, KBH_4, CaH_2.

MERCURY - Hazardous with ammonia, halogens, alkali. Vapors are extremely toxic and cumulative, but fortunately mercury is not very volatile at room temperature. A high degree of cleanliness should be maintained, apparatus containing mercury should be placed under an exhaust hood and in a collecting tray if possible, or at least handled at sites that can be readily cleaned -- not where the metal could accumulate beneath benches, lodge in rough floor surfaces, or fall upon heated surfaces such as pipes, hotplates, or ovens. Smoking should be avoided; washing hands and rinsing out mouth is advisable after operation is completed. Spills should be sprinkled immediately with sulfur or zinc powder and picked up with a capillary tube through a suction flask trap. A penny or a copper wire coated with mercury will pick up minute quantities. Spills on hot surfaces

such as with a broken thermometer in an oven must be regarded as extremely hazardous. Shut the oven door, turn off the heat, and leave the room until assured by the Safety Department that the area is safe to enter. Do not discard mercury into sink. For help in cleaning up gross spillage, call the Safety Department.

METHANOL - Known also as wood alcohol or methyl alcohol; death or blindness can be caused by ingestion, respiration, or skin absorption; in contact with the skin, it should be flushed off with a large quantity of water.

METHYL SILICATE - Extremely hazardous to eyes; destructive action continues on eyes after exposure ceases.

MONOCHLOROACETONE - Has exploded spontaneously in storage.

MONOPERSULFURIC ACID - Caro's acid in contact with primary or secondary alcohols or in too high a concentration in any organic media may explode.

NITRIC ACID - Hazardous with aniline, hydrogen sulfide, flammable solvents, hydrazine; metal powders, especially zinc, aluminum, and magnesium. Gaseous nitrogen oxides from nitric acid and from other nitrogen-containing compounds can cause severe lung damage and death several days after exposure although they produce little or no discomfort at the time of inhalation. A gas mask should be worn when cleaning up spills. Use caution when cleaning glassware. A slight residue could cause an explosion, inadvertently, when it is allowed to nitrate an organic substance introduced into the newly cleaned container. Acid cleaning mixtures should not contain more than 5 per cent nitric acid.

NITROBENZINE AND OTHER NITROAROMATICS - Readily absorbed through the skin. Symptoms of intoxication are typical of cyanosis - a sense of well-being, bluish tint of tongue, lips and fingernails.

NITROBENZOYL CHLORIDE - Ortho-nitroaromatic compounds (e.g., o-nitrophenyl acetyl chloride) are likely to explode when heated over 100°C. Should be used in solution without isolating the acid chloride.

NITROGEN - (Liquid) Produces a lower temperature than liquid air or liquid oxygen. Air and oxygen are potentially hazardous and should never be substituted for nitrogen as a coolant. Do not allow a rod or funnel to remain in the thermal type containers because ice formed from vapors may readily block the opening thus creating a potential bomb.

NITROMETHANE - Sodium and ammonium salts may explode without provocation. Do not subject to severe shock, high pressure or temperature or to reaction with sodium or potassium.

OXALIC ACID - Hazardous with silver and mercury.

OXIDIZERS - (Perchlorates, peroxides, permanganates, persulfates, perborates, nitrates, halogens, chlorates, chlorites, bromates, iodates; concentrated sulfuric, concentrated nitric, chromic acids.) Hazardous with most metal powders, ammonium salts, phosphorus, finely divided organics such as sugar, flammable liquids, acids, sulfur, sulfides, sulfites.

OSMIUM TETROXIDE - Absorbed through skin; extremely hazardous to the eyes.

PERCHLORIC ACID - Hazardous with drying agents (extremely sensitive to heat and shock when concentration is raised from 72 per cent and upward toward 90-100 per cent) such as sulfuric acid, acetic anhydride, bismuth compounds, almost all organic substances. Use caution when adding to water. In destroying organic matter, a preliminary treatment with nitric acid is recommended to destroy all easily oxidizable material.

PERFORMIC ACID - Has detonated for apparently no reason while being poured. Special precautions should be taken to distill.

PHENOL - The same as cresols, they behave not only as skin irritants but as a local anesthetic, so that burns may not be felt until serious damage has been done. They can be absorbed through the skin with fatal results. Clothing splashed with phenol should be changed immediately.

PHOSGENE - Lethal exposure can occur before any serious symptoms appear.

PHOSPHINE - May ignite spontaneously and explode violently; extremely toxic.

PHOSPHORIC ANHYDRIDE - Hazardous with water. Powerful dehydrating agents. Particularly hazardous to eyes. Small quantities may be disposed of by allowing it to liquify slowly upon exposure to air in the hood -- dispose in drain with large volume of water.

PHOSPHORUS - Although not a commonly used chemical, white phosphorus requires caution when used. In addition to its fire hazard (it ignites at 30°C in moist air), burning phosphorus sticks to the skin - hazardous in contact with oxidizing material.

PHOSPHORUS OXYCHLORIDE - Violent with water; an eye irritant.

PHOSPHORUS PENTASULFIDE - Not toxic or corrosive in itself but may ignite in air to form hazardous fumes. Releases hydrogen sulfide on contact with acid.

PHOSPHORUS TRICHLORIDE - Like all other phosphorus halides, it produces an extremely violent reaction with water and may form phosphine.

PICRIC ACID - In dry state, it is highly sensitive to shock, and in contact with metals and ammonia, it produces picrates which are more sensitive to explosion than the picric acid. Readily absorbed through skin and irritating to eyes.

POTASSIUM - More active than sodium. Use tertiary butyl alcohol rather than ethanol to destroy. Handle under xylene rather than the more mobile, volatile, and toxic benzene to minimize fire hazard. Keep a piece of noncombustible board nearby to smother possible fire and also a container of Met-L-X, an extinguishing agent obtainable from the Fire Marshal. Do not heat glassware containing metallic potassium beyond its melting point (62°C) - an explosive reaction with the glass can result.

POTASSIUM HYDROXIDE - Use extreme caution in adding water - since considerable heat is liberated, use Pyrex or metal container. Same for sodium hydroxide.

POTASSIUM PERMANGANATE - Decomposes with explosive violence under certain condition of excessive heat. Hazardous with sulfuric acid and organics.

PYRIDINE - A cumulative poison.

RESORCINOL - A skin irritant; in a suitable solvent, it can be readily absorbed through the skin.

SILVER - Hazardous with acetylene, oxalic acid, ammonium compounds.

SILVER NITRATE - Powerful oxidizing agent; strongly corrosive; dust or solid form is dangerous to the eyes.

SODIUM AMIDE - Unstable - fire and explosion hazard. Yellowish color indicates it is extremely sensitive to shock and should be destroyed.

SODIUM - Hazardous with water, organic halides, acids, warm alcohols, carbon dioxide. Do not expose large quantities to the atmosphere unnecessarily. Dispose of small quantities by slowly adding them to ethyl alcohol and then add water slowly to the ethanol. Make certain reaction is complete before pouring into drain. Large quantities should be disposed of by the Safety Department. Never use a water or carbon tetrachloride extinguisher on a fire; carbon dioxide extinguisher should be used cautiously - use dry sand or "Met-L-X."

SULFURIC ACID - Pour acid into water - never pour water into acid. Always Add Acid, is a readily remembered phrase. Before flushing out bottles with water, drain out all of the acid first and add water cautiously to prevent violent reaction. Wear a face shield during this operation.

TEFLON - Unheated dust is physiologically inert. Over 400°F, it may produce grippe-like symptoms for 36-48 hours. Do not smoke while handling.

TETRAHYDROFURAN - Forms high concentrations of peroxides.

TRICHLORETHYLENE - May react to form explosive mixtures with strong alkalies such as caustic soda to form dichloroacetylene.

WATER - Hazardous with alkali metals, acetyl bromide, acetyl chloride, benzoyl chloride, boron hydride, calcium barium peroxide, concentrated H_2SO_4, solid Na and K hydroxides, sodium peroxide, sodium amide, phosphorus oxychloride, phosphorus trichloride, phosphoric anhydride, sulfuryl chloride, thionyl chloride, chlorosulfonic acid.

ZIRCONIUM - Highly flammable in dry state. Hazardous with oxidizing agents.

SPECIAL INSTRUCTIONS

Potential hazards exist when students engage in the activities commonly performed in any science class, regardless of subject. Students and teachers may need to handle glassware, dispose of chemicals, use radioactive materials, and operate a laser or other electronic equipment. Several commonly available pieces of equipment may produce X rays. Students in physics classes or in science clubs frequently work with model rockets, and specific precautions must be taken. For each of these areas, the following specific guidelines are presented that, if followed, will greatly reduce the potential risk of student injury.

- Glassware that is to be heated should be of the borosilicate type such as Pyrex and Kimax. Never use soda-lime glass unless instructed to do so.
- Dispose of broken glassware in such a way as to minimize the danger of cuts. Use a dustpan and broom to pick up the large pieces of glass and wet cotton to pick up small ones. Do not pick up broken glassware with fingers.
- Glass is a poor conductor of heat. Therefore, you can even burn yourself on glassware that has been cooling for several minutes.
- Do not use glass when mixing potentially explosive compounds.
- Do not use glass reagent bottles for highly flammable materials. Less flammable materials in glass containers should be stored in metal receptacles large enough to contain the material in the event of breakage.
- Carry and/or store packages of glass tubing vertically.
- Handle "frozen" glass-to-glass surfaces with extreme care. Loosen the joints under a stream of hot water, but be sure to wear gloves or protect the hands with a towel.

Glass tubing is usually purchased in long sections. The following steps are to be taken in cutting the required lengths:

- Lay the tubing in a notch or groove on a flat surface or lay it on a flat surface, holding it firmly near the point where the cut is to be made.
- Draw the edge of a triangular file across the tubing to produce a deep scratch.
- Wear gloves or wrap the glass in a cloth before attempting to break it.

- Grasp the tube with both hands with the thumbs together on the side opposite the scratch.

- Snap the tube by pushing outward with the thumbs and simultaneously pulling back with the fingers.

- Fire polish the ends of glass tubing to be used in the laboratories by:

  Holding the glass tubing so the end is in the hottest part of the flame.

  Rotating the tube so all sides are heated evenly, causing sharp edges to visibly melt and become smooth.

  Placing the fire-polished tube on heat resistant material until it cools. Glass is a poor conductor of heat and takes several minutes to cool.

The following procedures are recommended for bending and drawing glass tubing into needed configurations:

- Place a wing-top flame spreader on the burner.

- Hold the tube with both hands and heat the area to be bent.

- Rotate the tubing to ensure even heating of all sides.

- Once the part of the flame around and above the blue portion becomes a distinct yellow, the glass is soft enough to bend or draw.

  To bend: Quickly place the glass on a heat resistant pad and immediately bend to the desired angle.

  To draw: When the glass becomes soft, pull both ends of the glass tubing. This pull should be done smoothly, with even tension. When the desired size and length are attained, lay the tube on a heat resistant pad to cool. Cut and fire polish it.

To prevent injuries when inserting glass tubing or rods in cork or rubber stoppers:

- Fire polish all glass tubing.

- Use a lubricant when inserting glass tubing or thermometers into rubber stoppers.

- To put glass into the stopper:

  First run a cork borer through the stopper. Then slip the glass tubing into the cork borer, withdraw the borer, leaving the tube in the stopper; or

  Wrap the tubing in several layers of cloth. Holding the tubing as near to the stopper as possible, push (do not force) the tube into the stopper. Always aim the tubing away from the palm of the hand holding the stopper.

To remove glass tubing, rods, or thermometers from old stoppers, cut away the stopper rather than risk injury from broken glass.

When clamping glassware:

- Wrap the glass in cloth or paper before clamping. Rubber may be used if the apparatus is not to be heated.
- Use care in tightening the clamp. Excessive tightening will bend the clamp or break the glass.

Cuts and burns may result from improper use of glassware. To minimize injuries:

- Use care in selecting glassware to be heated. Only Pyrex or similar heat-treated types should be used.
- When heating a flask or beaker over an open flame, place the glassware on a plain wire gauze to disperse the heat.
- Any localized overheating may crack glassware. Always heat glassware as slowly and evenly as possible.
- Do not use soft glassware with a reaction that produces heat.

X-RAY EQUIPMENT

Registered X-ray equipment should only be operated by persons specially trained in its use. At no time should a science teacher operate or permit students to operate equipment known to produce significant X rays. There are three types of cathode ray tubes commonly used for classroom demonstrations that are capable of producing potentially hazardous X rays; they are:

- Heat effect tube--used to show that cathode rays consist of rapidly moving electrons possessing kinetic energy that can be converted into heat
- Magnetic or deflection effect tube--used to show that cathode rays possess a charge and deflect in the presence of a magnetic field
- Shadow or fluorescence effect tube--used to show that cathode rays (electrons) can cause light to be omitted when colliding with fluorescent material coating the walls of the tube

X rays may be produced whenever the potential difference between anode and cathode is in the 10 kilovolt range (10,000 volts or more), a source of electrons and a target is present, and the tube possesses a good vacuum. When using any of the three tubes as part of a classroom demonstration, be sure to:

- do the demonstration yourself (never permit the student to hold the tube).
- operate the tube at a low current and voltage for only a short period of time.
- keep the student at a safe distance (at least eight feet) from the tube.

Compliance with these guidelines will greatly reduce the risk of exposure to X rays.

MODEL ROCKETS

At a time when model rocketry is gaining popularity (especially among students in science clubs), it is important that science teachers be aware of both the potential dangers of model rockets as well as the rules of safety for their use. Interest in model rockets affords physical science teachers many opportunities to enrich the study of such topics as energy, energy conservation, forces, and vectors. Considerable

risk to the safety of students and teachers is introduced whenever rockets of the homemade variety are used; these must be avoided. Most model rockets purchased from commercial suppliers conform to the regulations stipulated by the Federal Aviation Agency. In any event, check all model rockets against the following guidelines before operation.

- There should be no metal used as a structural part. Wood, plastic, paper, rubber, or similar materials may be used, but under no circumstances is the total mass of the rocket and engine to exceed 453 grams.

- Use only solid propellant reaction engines produced by commercial manufacturers. Follow the manufacturer's directions carefully, using no more than 113 grams of propellant. Never use homemade propellants.

- No rocket is to be fired without a recovery system made from nonflammable wadding. This prevents damage to the rocket as well as ensures the safety of both persons and property on the ground.

- Only launch rockets of proven stability and predictable flight paths.

- Launch through a remotely controlled and electrically operated switch that will return to the off position when launched. The system should have a jet deflector to prevent the engine exhaust from directly hitting the ground. All persons must stand at least six meters from the rocket prior to launching, preferably behind a protective barrier.

- Never launch rockets at an angle less than 60 degrees from the horizon; in high winds; near buildings, powerlines, or tall trees; in the paths of flying aircraft; or under any condition that might endanger either people or property.

- Be sure the launch area is free from flammable materials. The smallest dimension of the ground area should be no less than one-quarter the anticipated maximum altitude the rocket is to be flown.

- Never launch a rocket so that its flight will carry it to a ground target. Similarly, never equip a rocket with an explosive head.

RADIOISOTOPES

The federal government (under the U.S. Energy Research and Development Administration) has granted permission for teachers to use radioactive materials of low hazard potential. Among the materials available for use are Carbon-14, Phosphorous-32, and Iodine-131. Use of materials other than those whose activity is in the microcurie range requires a special license. Observe the following safety precautions whenever radioactive materials are used:

- Keep accurate records of the kinds and quantities of radioactive materials possessed and which students either used or were present when the materials were used.
- Label all radioisotopes "Radioactive" and store them in locked cabinets conspicuously marked "Radioactive Material."
- Do not premit food, drink, or use of cosmetics in the general vicinity of the lab.
- Keep radioisotopes away from the eyes, mouth, and open sores.
- Pipette radioactive solutions only by bulb; do not use mouth suction.
- Use a fume hood when performing experiments in which there is a danger of inhaling fumes.
- Use tongs and rubber gloves when handling radioisotopes and scrub hands immediately thereafter.
- Use a detection device (such as a Geiger counter) to monitor the activity of all specimens brought to the laboratory and to check the hands after handling radioisotopes.
- Properly dispose of all contaminated materials after using. Should there by any question concerning the proper methods of disposal, contact the Okla. Department of Health.

NONIONIZING RADIATION

Potential hazards are present whenever sources of ultraviolet, infrared, or microwave radiation are used. Teachers using such sources must provide adequate shielding for students' eyes and limit the length of time that the sources are used. The harmful effects incurred as a result of improper shielding are not immediately noticed. For best results, appropriate filters should be attached to the source rather than having

students wear protective goggles. Mercury light sources (capable of emitting ultraviolet radiation), such as those purchased from scientific supply houses, are usually fitted with the proper shielding by the manufacturer; be sure the shielding is in place before allowing the sources to be used.

LASER SAFETY

The use of lasers in the science classroom has become increasingly popular. With the introduction of the low-powered Helium-Neon (He-Ne) gas lasers (1 milliwatt range), they are now commercially available at a nominal cost. He-Ne gas lasers can be used to demonstrate a wide range of optical phenomena. Ninety-two percent of the lasers used in high schools are of the He-Ne type. Their low output (found to range from 0.19 to 3.0 milliwatts) does not mean that these devices should be considered safe for students to handle. To the contrary, even the low output He-Ne beams are capable of burning the retinal area of the eye, producing a blind spot. Sufficient energy is deposited in .01 seconds under direct viewing of a laser beam to cause retinal damage. Under no circumstances should you use a He-Ne laser in the presence of students without first informing them of the possible dangers and then instructing them as to the proper rules of safety. Read the manufacturer's guide when available to ensure proper use. In addition, observe the following safety rules:

- Never look directly into the beam. Should beams of higher power than the He-Ne type be used, avoid placing any portion of the body in the beam's path, as the possibility of skin burns increases with beam output power.

- Never look at the reflected beam. Shiney objects that may scatter the beam introduce unnecessary risks to the eyes of both student and teacher. Commonly available welders' goggles may not offer sufficient protection against the reflected beam.

- Block or turn off the beam when not in use.

- Supervise students closely when a laser beam is in use.

- Be sure lasers are properly grounded (three-prong plug) when in use. Under no conditions should a teacher or student remove the external cover while a laser is in operation; the voltages used are lethal.

- Whenever students use a laser beam, insist upon strict adherence to rules of safety. Students wearing corrective lenses may accidentally come into contact with a reflected beam. For example, if a student sitting along a line opposite that of the beam's direction

leans into the beam, the near side of one of the lenses may catch the beam and reflect it into the eye.

ELECTRICITY AND ELECTRONIC EQUIPMENT

A common cause of injuries in high school laboratories arise from electrical shock. Opportunities for electrical mishaps abound in physics and physical science laboratories, since either electricity or some type of electrical apparatus is used even in mechanics lab activities. Although contact with any voltage will produce a shock, the current flow determines the effect on the body; the higher the current, the greater the risk of injury. At a let-go current of 10 milliamps (0.01 amp), muscular paralysis sets in; at 100 milliamps, skin burns and ventricular fibrillation occur. A current greater than 200 milliamps (0.2 amp) is fatal. Most voltages that a student would come into contact with are fixed (e.g., 110 volt A.C.). Also, the greater the body's resistance to current, the less likely the possibility of severe injury or death. While the best advice is to never allow the body to come into contact with electricity, this is impractical. Strict adherence to the following rules will greatly reduce the threat of injury.

- Check all electrical equipment before using to see that there are no exposed or frayed wires. Should repair be needed, be sure the piece of equipment is disconnected and consult a qualified person.
- Never handle electrical equipment with wet hands. To do so decreases the body's resistance to current flow thus increasing the risk of severe or fatal shock. Dry skin may have a resistance as high as 500,000 ohms, while wet skin may be as low as 100 ohms. As an added precaution, stand on a dry rubber mat.
- Never permit students to work around electrical equipment without their shoes on.
- Extension cords pose potential problems; refrain from using them if possible.

DANGER SYMBOLS

Poison*

Poison

Biohazard

Radiation

Caustic
or
Corrosive

Electric
Hazard

Loud
Noise

Sharp
Object

Noxious
Fumes

Microwave

Laser

Steam

Bee

Insect
or
Spider

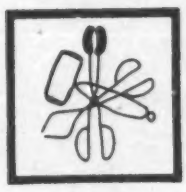
Snake

SYMBOLS FOR RECOMMENDED USE

Lab Coat

Glasses

Pipette
Bulb



Tongs

Gloves

*Effective with young students.

STORAGE

Extreme caution must be exercised in science laboratory storage to insure a safe teaching environment.

Precautionary measures should include:

- A well-organized chemical stockroom and storage area.

  An inventory showing material on hand, and the location of such material should be posted in a conspicous place.

  Materials with high danger potential should be identified in the inventory, on the container, and in the storage area. The nature or the hazard should be indicated where possible, i.e. incendiary, explosive, caustic, contact poison, poisonous fumes, stomach poison, etc.

  Materials which will not be used should be disposed of safely. Included are materials which may become contaminated if not used or materials of questionable content.

  The department chairman or teacher in charge of chemical storage should keep informed about hazardous materials through contact with the American Chemical Society, National Science Teachers Association, The Occupational Safety and Health Administration (OSHA) and local universities.

  Caustic liquids should be stored on shelves that are below waist level.

- The stockroom and/or storage area should be well ventilated so that poisonous fumes cannot accumulate.

- A procedure should be established for providing periodic checks of hazardous materials which require special storage. Among such materials are the alkali metals and phosphorus.

- The storage area must be kept secure; only authorized personnel should have access to it. Every safeguard should be taken to prevent unauthorized use of hazardous material.

Purpose

To develop acceptable safety practices in general and to assist the student in developing a favorable attitude toward safety practices.

Materials transferred from labeled containers, all preparations from materials obtained from sources other than labeled containers, and all preparations made from a combination of labeled containers and other sources shall have a label containing the following information:

- Name or title of material
- A list of ingredients
- Directions for use
- A warning or caution
- Date prepared
- Storage instructions
- A hazardous symbol and a risk number (developed by teachers)

A laboratory reagent log shall be maintained by the science teachers. This log, to be indexed by formulation titles, shall contain all the information shown on the label.

Rationale for Labels

If an individual is injured by coming into contact with a chemical, person(s) who provide first aid will need to identify it. A hazardous material in a cleaning solution may not be readily identifiable by the words "cleaning solution". It is imperative to know all of the ingredients of any chemical preparation.

STORING CHEMICALS

Many chemicals react violently, produce toxic fumes, and are fire hazards when they interact. The chemicals listed in the left-hand column should be stored in a manner that will prevent them from coming in contact with those in the right-hand column.

Do Not Store:	Close To:
Acetic acid	Chromic acid, nitric acid, perchloric acid, ethlylene glycol, hydroxyl compounds, peroxides, and permanganates
Acetone	Concentrated sulfuric and nitric acid mixtures

Do Not Store:	Close To:
Acetylene	Bromine, chlorine, fluorine, copper tubing, as well as silver, mercury, and their compounds
Alkali metals (K, Na, Ca), powdered aluminum, and magnesium	Water (K & Na), carbon dioxide, carbon tetrachloride, and the halogens
Ammonia, anhydrous	Mercury, hydrogen fluoride, and calcium hypochlorite
Ammonium nitrate (a deliquescent, hygroscopic, powerful oxidizing agent)	Strong acids, metal powders, chlorates, nitrates, sulfur, flammable liquids, and finely divided organic materials
Aniline	Nitric acid and hydrogen peroxide
Bromine	Ammonia, acetylene, butane, hydrogen, sodium carbide, turpentine, finely divided metals
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, strong acids, powdered metals, sulfur, and finely divided organic materials
Chromic acid	Glacial acetic acid, camphor, glycerin, naphthalene, turpentine, lower molecular weight alcohols, and many flammable liquids
Chlorine	Same as for bromine
Copper	Acetylene and hydrogen peroxide
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, sodium peroxide, nitric acid, and the halogens
Hydrocarbons (butane, propane, benzene, gasoline, and turpentine)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron (most metals or their salts), flammable liquids, and other combustible materials

Do Not Store:	Close To:
Hydrogen sulfide	Nitric acid and certain oxidizing gases
Iodine	Acetylene and ammonia
Nitric acid	Glacial acetic acid, chromic and hydrocyanic acids, hydrogen sulfide, flammable liquids, and flammable gases that are easily nitrated
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, and gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohols, paper, wood, and other organic materials
Phosphorus pentoxide	Water
Potassium permanganate	Glycerine, ethylene glycol, and sulfuric acid
Silver	Acetylene, ammonia compounds, oxalic acid, and tartaric acid
Sodium peroxide	Glacial acetic acid, acetic anhydride, methanol, carbon disulfide, glycerine, benzaldehyde, and water
Sulfuric acid	Chlorates, perchlorates, permanganates, and water

NOTE: The Manual of Hazardous Chemical Reactions is recommended for high school science departments. The 470-page book (491M) is available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

STORAGE OF HAZARDOUS MATERIALS

All hazardous materials such as caustics, acids, poisons, flammables, etc., should be treated with the utmost caution. They should be present in the laboratory only if they are essential to providing a valuable learning experience. All such materials must be used only under the direct supervision of a qualified instructor.

The storage area for such material should be power ventilated to prevent the accumulation of toxic fumes and should be kept locked when it is not supervised. Clean, orderly conditions should prevail at all times.

All caustic materials should be stored on or near the floor, thus reducing the danger of the materials spilling on a person in the stockroom. Labels should be kept in good, readable condition. Antidotes for special caustics should be kept convenient to storage and working areas.

Spontaneous combustibles such as phosphorus, sodium, potassium, etc., should be stored in air-tight containers. The levels of covered liquids should be checked at intervals not greater than three months.

Materials which will not be used should be discarded by a person qualified in chemistry. Assistance may be obtained from local fire and health departments and from the local American Chemical Society section.

The following 14 carcinogens are regulated and should not be used in a high school program:

- Benzidine
- Bis(chloromethyl)ether
- B-Propiolactone
- 3,3'-Dichlorobenzidine
- B-Naphthylamine
- 2-Acetylaminofluorene
- 4-Aminodiphenyl
- 4-Dimethylaminoazobenzene
- 4-Nitrobiphenyl
- 4, 4'-Methylene-bis(2-Chloroaniline)
- Chloromethyl Methyl ether
- N-Nitrosodimethylamine
- Ethylenimine
- Vinyl Chloride

Disposal of unwanted hazardous materials should follow the best safety procedures and should be carried out by the instructor or other qualified personnel. Attention is called to the Laboratory Waste Disposal Manual; F. G. Stephen (Ed.) Manufacturing Chemists Association; 1969.

Although disposal techniques vary, they should be designed to avoid potential hazards to the school personnel and the environment.

CHEMICAL DISPOSAL

The problem of safe disposal of chemicals is important not only for the chemist but for those who might later come in contact with the material. The nature and quantity of a chemical must be considered in light of new national pollution laws to protect our environment. Chemical wastes should not be permitted to accumulate. Items should be properly disposed of immediately after they are no longer needed.

Disposal procedures are numerous and some are complex. The steps for disposing of chemicals usually encountered in science teaching present few major obstacles.

Neutralize common bases with diluted sulfuric acid. Then wash the nautral solution down the drain with an excess of water.

Neutralize common acids with sodium carbonate, and then wash them down the drain. Dispose of salt solutions in the same manner. All materials disposed of by washing down the drain should be soluble in water. Never flush materials down the drain that are either volatile, toxic, or insoluble.

Burn hydrocarbons, preferably in a solvent burner. Halogenated hydrocarbons should be burned in the presence of calcium hydroxide or sodium carbonate.

The following is a list of elements and compounds that according to the Manufacturing Chemists Association can be dumped into landfills or released into the air:

- Argon
- Asphalt
- Batteries (dry cell)
- Boron
- Calcium carbonate
- Calcium oxide
- Carbon black
- Chromium
- Crude lime
- Epoxy resin systems
- Ferrosilicon
- Helium
- Hydrogen
- Lamp bulbs
- Latex
- Magnesium oxide
- Metal scrap
- Molybdenum, insoluble compound
- Neon
- Nitrogen
- Nitrogen fertilizers
- Nitrogen trioxide
- Oxygen
- Ozone
- Paint
- Resin
- Rubber
- Scrap glass
- Scrap stoneware
- Silica
- Sludges
- Stones, alberine
- Sulfur
- Sulfur hexafluoride
- Tar
- Tin, organic compounds
- Titanium oxide
- Tremolite
- Urea
- Zinc oxide

Report to the departmental chairperson overaged or sulfur chemicals that, because of toxicity, pollution potential, or explosive danger, cannot be disposed of by dissolving, diluting, or flushing down the drain. Similarly, report carcinogenic compounds to the departmental chairperson, then contact the appropriate disposal agency for action.

Unstable elements, compounds, or mixtures may decompose explosively. A few such substances are routinely stocked in high school laboratories and require special precautions and handling. Among these are:

- Ether
- Formic acid
- Ammonium nitrate
- Sodium
- Potassium
- Lithium
- Phosphorus
- Ammoniacal silver nitrate solutions
- Benzoyl peroxide
- Nitrogen triiodide
- Picric acid
- Perchloric acid

A list of alleged cancer-causing compounds found in one state survey of science laboratories follows:

- 4-Nitrobiphenyl
- alpha-Napthylamine
- beta-Napthylamine
- Methyl chloromethyl ether
- 3,3'-Dichlorobenzidine
- Benzidine (4-4' Diaminobiphenyl)
- 4-Aminobiphenyl
- Ethyleneimine
- beta-Propiolactone
- aipha-Acetylaminofluorene
- 4-Dimethylaminoazobenzene
- N-Nitrosodimethylamine
- Vinyl chloride
- Acetone

Specific information on how to handle carcinogens may be obtained from:

Department of Epidimeology
Oklahoma Department of Health
1000 N.E. 10th
Oklahoma City, OK 73152
405/271-4060

Specific information on how to handle radio-isotopes may be obtained from:

Occupational and Radiological Health
State Department of Health
1000 N.E. 10th
Oklahoma City, OK 73152
405/271-5221

Specific information on poison and drug control may be obtained from:

OK Poison Control Center
Oklahoma Children's Memorial Hospital
800 N.E. 13th
Oklahoma City, Oklahoma 73104
405/271-5454

Bureau of Narcotics & Dangerous Drugs Control
680 Jim Thorpe Building
Oklahoma City, Oklahoma 73105
405/521-2885 or 1-800-522-8031

The following firms will provide assistance in disposing of hazardous chemicals and commercial industrial solid wastes:

Company and Mailing Address,
Area Code/Telephone Number

Techrad
4619 N. Santa Fe
Oklahoma City, Oklahoma 73118
405/528-7016

U. S. Pollution Control
2000 Classen Center, Suite 320 South
Oklahoma City, Oklahoma 73106
405/528-8371

U. S. Pollution Control, Inc. SD47002
Lone Mountain Surface Disposal site OKD065438376
RR2, Box 180A
Waynoka, Oklahoma 73860
405/697-3237

Lamberton Acid Waste Disposal
Fourth National Building
Tulsa, Oklahoma 74119
918/582-6994

Lamberton Acid Waste Disposal
West Tulsa plant
2700 S. 25 W. Ave
Tulsa, Oklahoma 74107
918/582/9595

Energy Systems Company AR0249
P. O. Box 1975 ARD069748192
El Dorado, Arkansas 71730
501/863-7173

Company and Mailing Address, Area Code/Telephone Number	
Chemical Waste Management, Inc. Highway 17, Mile Post 163 Emmelle, Alabama 35459 205/652-9531	AL00781 ALT000622464
Rollins Environmental Services (TX) Inc. 2027 Battle Ground Road Deer Park, Texas 77536 713/479-6001	TX91429 TXD066141378
Kansas Industrial Environmental Services 8808 N. 127th Wichita, Kansas 67202 316/744-1286	

BASIC FIRST AID SUPPLIES

The following list of first-aid supplies is suggested for each science laboratory:

Items	Quantity
Adhesive tape: one-inch roll	1
two-inch roll	1
Sterile gauze squares in two-unit package (four inch by four inch)	12
Roller gauze bandage, unsterile	
Widths: two inch	4 to 6
four inch	4
six inch	2
Surgipads eight inch by seven-and-a-half inch or clean, thick cloth padding for compression	4
Sterile eye pads in single-unit package or sterile gauze squares (two inch by two inch) in two-unit packages	4 to 6
Assortment of adhesive strips	1 box
Bandage scissors	1 pair
Tweezers	1 pair

Be sure to store the supplies in a sturdy container large enough for all supplies to be arranged in an orderly fashion and to be quickly accessible without unpacking the entire contents. Wrap opened supplies so that the unused portions remain clean. Regularly take stock of the contents of the kit and replace used items as needed.

In addition to supplies, the following equipment should be readily accessible to each science laboratory:

Fire extinguisher (ABC types).* Know location and how to operate.

Fire blanket. Use to smother fire on clothing and equipment.

Sand bucket. Use to smother chemical fires.

*The multipurpose ABC-type dry chemical fire extinguisher covers all fire classes except those involving reactive and combustible metals such as sodium, lithium, potassium, magnesium, and certain metallic hydrides and alkyds.

Emergency shower facility. Use to flush chemicals off body.

Safety goggles. Use when working with chemicals.

Laboratory aprons. Wear to protect clothing.

Heat resistant gloves. Use to transfer hot liquids.

Wire gauze and/or heat-resistant-centered wire gauze. Use for heating containers of liquid.

Eyewash facilities. Use to flush chemicals from eyes.

Backboard. Use in the event of a back injury. However, DO NOT USE A BACKBOARD UNLESS QUALIFIED MEDICAL PERSONS ARE AVAILABLE; THE STUDENT MAY SUSTAIN PERMANENT NERVE DAMAGE. Should it be necessary to use a backboard follow these steps:

Roll the person onto one side.

Place backboard beneath the victim.

Rotate the victim onto the board.

Consult a medical person immediately.

Report incident to school authorities.

FIRST AID PROCEDURES

Injuries are possible in any classroom; however, they are particularly likely to occur in the science classroom. While prevention is the first and most important safety measure to apply, you, the science teacher, must know what action to take in the event an injury does occur. In most cases, first aid doesn't involve treating the victim but simply preventing further injury until a physician can give treatment. If possible, learn the principles of first aid by taking a first aid course offered by the American Red Cross. In the meantime, the following guidelines will help you handle the injuries most commonly found to occur in a laboratory or on a field trip.

INJURY	WHAT TO DO
OPEN CUT OR PUNCTURE:	
MINOR--(skin is broken, bleeding is more seeping or oozing)	In a cut from glass, remove any glass fragments, clean by flushing with water then soap and water. Apply a sterile dressing. If in doubt about all glass being removed, seek further medical attention. In other minor lacerations, clean with soap and water then cover with a sterile bandage. Because puncture wounds usually are not naturally flushed out by external bleeding, they are more likely to become infected. Therefore, it is important in a puncture wound to clean thoroughly by a five- to 10-minute soak in soapy water followed by scrubbing, then a dry sterile dressing applied. Here adequate protection from tetanus is also a consideration. Since tetanus grows in the absence of air and in the presence of warmth and moisture, the puncture wound should have medical attention to prevent tetanus.
MAJOR--(more than a seeping or trickle of blood, laceration below the outer skin level)	If bleeding is severe, apply direct pressure with a sterile or clean pad directly over the cut. Keep constant, steady pressure applied. Additional layers of cloth or dressing may be applied but do not remove the original pressure dressing, even after bleeding is under control.

Elevate the limb with the dressing in place under pressure to a point above the victim's heart level to also reduce blood loss. Bandage may be secured firmly or snugly over the wound for transporting to further medical treatment.

NOTE: Bleeding can almost always be controlled by direct pressure over the wound. Use of a tourniquet can result in severe damage or loss of a limb and should be used only as a last resort measure to save a life (i.e., an amputated extremity).

BITES AND SCRATCHES:

MAMMALS-- Allow to bleed briefly. Apply an antiseptic solution and cover with a sterile compress. Take the person to a nurse or physician. Isolate the animal for a minimum of 10 days for observation. Should the animal die during this period, contact the health department for instruction. Refrigerate but do not freeze the body of the animal.

REPTILES-- Determine whether or not the reptile is poisonous. If poisonous, carefully follow the directions in the first aid manual and seek medical attention immediately. If non-poisonous, treat the bite in the same manner as small mammal bites and scratches. Quarantine and observation of the reptile is recommended in the event the bite or scratch becomes infected.

INSECTS AND SPIDERS-- Determine the type of insect inflicting the wound. Most bites are merely mechanical and should be treated as a small mammal bite (let bleed, apply antiseptic, apply sterile compress). Hypersensitive reactions may result from an insect or spider bite. Should medication for the hypersensitivity be available, apply

it according to directions. Should medication not be available, get medical attention as quickly as possible.

BURNS:

THERMAL TO SKIN-- Application of cold is the best first-aid measure. Soaking the burned area in ice water or applying cold towels gives immediate pain relief and restricts local tissue edema and damage. After a 20-minute period, if pain is still present, you may repeat the process. Then cover quickly to minimize bacterial contamination and decrease pain further. Sterile dressings are best, but any clean dry cloth can be used in an emergency. Do not apply ointments, creams, or antiseptics to a burn.

BURN TO SKIN-- Immediately flush skin with large quantities of running water for at least 10 minutes. Apply stream of water on skin while removing clothing saturated with caustic chemical. Cover burn area with a moist sterile dressing following the washing process. Consult physician.

CLOTHING ON FIRE-- Immediately have the victim fall to the floor. Wrap victim in fire blanket and roll on the floor to smother flames. (Standing would force him or her to breathe flames and smoke.) Soak hot clothing with cold water. Do not try to remove charred clothing. Cover victim with a dry blanket to prevent loss of body heat.

EYE INJURIES:

BURNS TO EYES-- Hold eyelids open and wash eyes with a gentle stream of cool running water. The rubber hose with your emergency supplies can facilitate eye irrigation at any available

faucet. A delay of even seconds can greatly increase the extent of a chemical eye burn injury. Continue washing for at least 15 to 20 minutes covering both eyes between washings until further medical instructions are received or victim is transported to hospital.

FOREIGN BODY IN EYE-- Glass or metal fragments should only be removed by a physician. Do not allow victim to rub eyes. This may imbed the fragments. Cover both eyes, even if only one eye is affected, with sterile gauze or eye pads and then a loose bandage. This is necessary to prevent movement of the injured eye. Do not put an ointment or drops in the eye since this will interfere with the doctor's examination. Keep the victim at rest and obtain medical treatment immediately. Transfer the victim on his or her back if at all possible.

DAMAGE TO EYE BODY OR LID-- Any damage to the eyeball or eyelid that causes bleeding should have prompt medical attention. No attempt should be made to apply any form of local treatment. Again, cover both eyes with eye pads and transport to a medical facility.

SHOCK: Keep victim quiet, covered, and lying down while en route to the hospital. Treat for probable shock in any serious injury (burns, cuts, etc.) by keeping the victim flat, keeping him or her warm and reassured until medical help is obtained.

Take every precaution to eliminate or greatly reduce the risk of personal injury in the science classroom. However, to act swiftly and promptly in the event of an injury, remember the following first-aid and emergency tips:

- Secure the victim from further harm.
- Report the incident to the school authorities.

- All students and teachers must know the location of fire extinguishers, eyewash fountains, safety showers, fire blankets, and first-aid kits.
- All safety equipment must be accessible at all times.
- Fire extinguishers must be recharged or replaced immediately after each use. Unused extinguishers must be inspected at least once a year.
- Use safety signs to identify the location of safety equipment.
- Post emergency instructions concerning fire, explosions, chemical reactions, spillage, and first-aid procedures conspicuously near all storage areas.
- Whenever possible, display current safety posters in science laboratories.

LABORATORY SAFETY CHECKLIST

Check all physical facilities annually using the following checklist. File a copy of the checklist with the building principal and take prompt action to correct any unsafe conditions and practices so that maximum safety is ensured at all times.

Notify in writing the principal and department chairperson of the existence of any hazard.

Section I: LABORATORY-CLASSROOM

Safety Factor	Yes	No	NA
Laboratory has two exits.	___	___	___
The emergency exit procedure is posted.	___	___	___
A general alarm system is provided for the entire building.	___	___	___
Individual student work stations are provided (number of students does not exceed the number of work stations).	___	___	___
Work surfaces are made of nonporous and chemical-resistant materials.	___	___	___
Safety rules are posted in the laboratory.	___	___	___
A master water cut-off valve is conveniently located.	___	___	___
A master electricity cut-off switch is conveniently located.	___	___	___
A master gas cut-off valve is conveniently located.	___	___	___
Aisles are wide enough so that teachers and students can move freely without interfering with other's work.	___	___	___
A key is provided to lock the laboratory-classroom when not in use.	___	___	___
Separate storage area is provided for large containers of dangerous reagents, e.g., five-liter bottles of concentrated acid.	___	___	___
An adequate room ventilation system is provided in all laboratories using volatile substances.	___	___	___
Household type refrigerators are not used for chemical storage.	___	___	___

Safety Factor	Yes	No	NA
A safety shower is available in all chemistry laboratories.			
Facilities for flushing the eyes are available.			
Proper types of fire extinguishers are accessible.			
Rubber or plastic gloves are available for student use.			
Approved eye protection devices are available for each student.			
Approved respiratory protection devices are provided to filter dust and organic vapor.			
Approved laboratory aprons are available for each student.			
Approved fire blankets are available in each laboratory.			
Sand buckets are available in each laboratory.			
Heat resistant gloves are available for student use.			
Operational fume hoods are provided in laboratories where noxious or toxic chemical fumes are used.			
Fume hoods have operational safety-glass access windows.			
Fume hood is clear and clean (not used as a storage area).			
Earthenware waste jars are provided in each laboratory.			
Floor is clear of refuse and equipment.			
No refuse is left in laboratory overnight.			
A container of an acid neutralizer is available in chemistry laboratories.			
All electrical outlets provide a grounded connection.			
All electrical equipment and appliances are properly grounded.			
Sufficient, properly installed electrical outlets are provided so as to eliminate the use of extension cords.			

Section II: STOREROOM

Safety Factor	Yes	No	NA
The storeroom is well lighted, has no blind alleys, and is forced-ventilated.	___	___	___
There is adequate space in the storeroom to provide storage for all chemicals and supplies.	___	___	___
All reagent chemicals are labeled.	___	___	___
All unlabeled reagents are disposed of properly.	___	___	___
Chemicals such as oxidizing and reducing agents that might react together are stored separately.	___	___	___
Volatile liquids are stored far away from heat sources and electrical switches.	___	___	___
Dangerous chemicals used in the laboratory are kept in small quantities.	___	___	___
Old and deteriorating chemicals are to be disposed of properly.	___	___	___
All acids and other corrosive materials are stored on or near the floor.	___	___	___
Large containers of chemicals are stored near the floor.	___	___	___
An appropriate fire extinguisher is located in each storeroom.	___	___	___
Protective gloves are available for transferring hazardous chemicals.	___	___	___
Different storage areas are provided to separate chemicals from delicate equipment, e.g., meters, microscopes.	___	___	___
Metal shelf supports are inspected frequently for signs of chemical corrosion.	___	___	___
A cart is provided to transport materials from storeroom to laboratory.	___	___	___
A horizontal bin near the floor is supplied to store glass tubing.	___	___	___